



Imaging Moving Objects in the Presence of a Dispersive Horizontal Reflector

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Abstract

Over-the-horizon radar uses reflections of electromagnetic radiation off of the ionosphere to extend range of detection. Current systems use a system of nearly co-located transmitters and receivers to produce low-resolution images. Better resolution could potentially be obtained from multiple input/output imaging systems. The theory for such systems has been developed for free-space environments; the present work incorporates a model of the ionosphere as a dispersive horizontal surface. We develop a linearized imaging theory that combines the spatial, temporal, and spectral components of multiply scattered waves. We consider the case of multiple fixed sensors viewing a distribution of multiple moving objects after being reflected of the dispersive reflector. We use a priori information about the target scene and multipath background of interest. We arrive at a solution to the forward scattering problem by employing an image method and using a stationary phase approximation in order to arrive at a data model dependent on sensor positions, take-off angle, and time of arrival. We form an image using a modification of a tomographic, filtered backprojection method that produces a phase-space image. We analyze the image via a multi-dimensional point-spread function and we identify how the imaging system reacts to parameters such as frequency, number of sensors, and wave path. We demonstrate, through example, that enhanced phase-space resolution for a distribution of stationary targets, in the presence of a dispersive reflector, may be achieved via a tomographic approach with a priori knowledge about the wave path and the nature of the multipath scattering.

Biography

Dr. Analee Miranda (Ph.D., Mathematics from Rensselaer Polytechnic Institute in Dec 2010) has been working as a researcher in the Air Force Research Lab since 2009. Her current research interests are: Inverse Problems, Electromagnetic Scattering, and Radar Imaging. She is a charter member and vice-chairman of the Applied Mathematics Working Group at the Air Force Research Lab. She is also an active member of the Society for Industrial and Applied Mathematicians (SIAM,) AFRL Sensors Directorate Junior Force, and the Society for Hispanic Professional Engineers (SHPE.) She also serves as an adjunct faculty member in the Department of Computer Science and Engineering at Wright State University.